



# Climate Change and its Implications for Conservation and Natural Resource Management

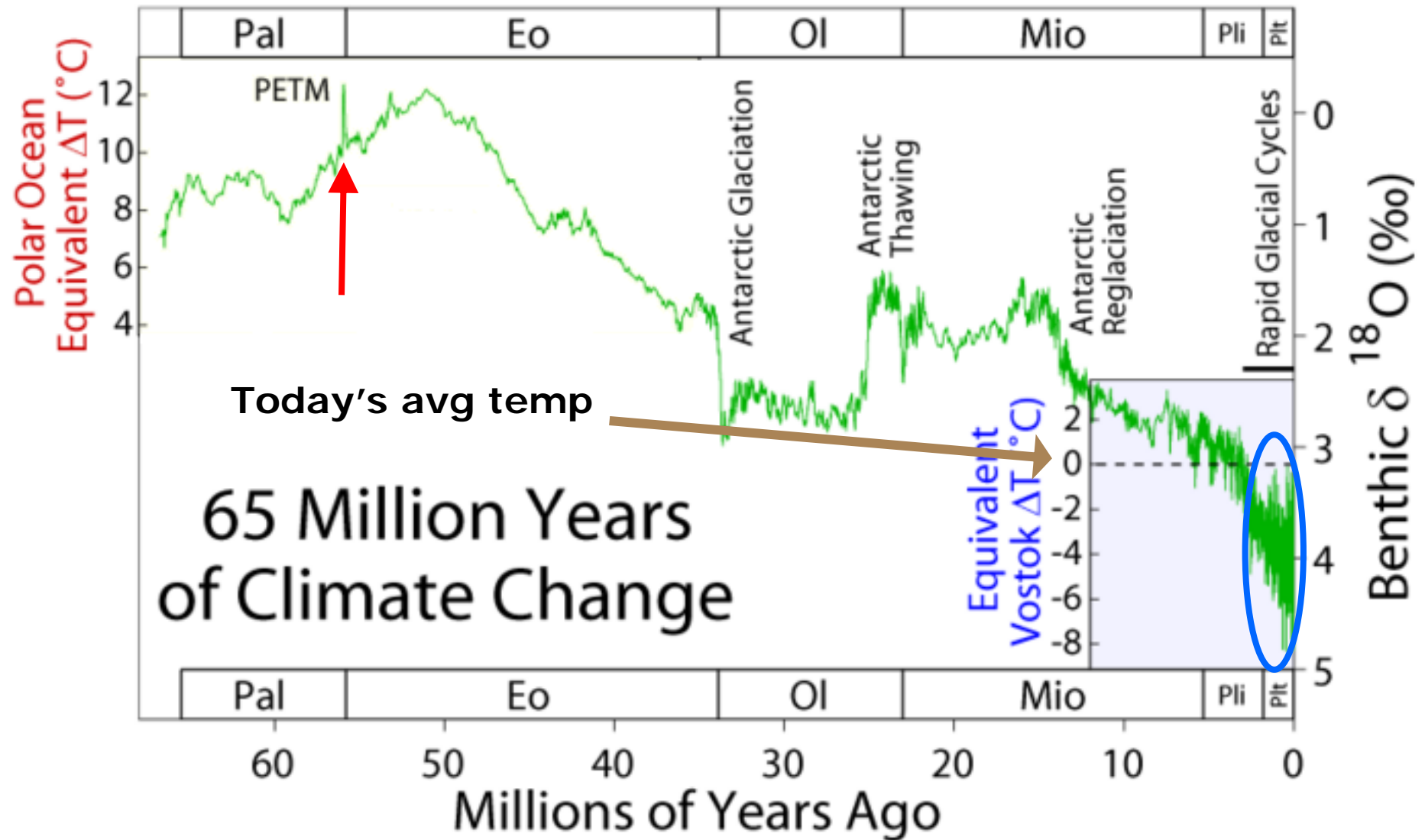
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U.S Fish and Wildlife Service  
Pacific Islands Fish and Wildlife Office

A stylized, dark teal silhouette of a mountain range is positioned in the bottom right corner of the slide, partially overlapping the text area.

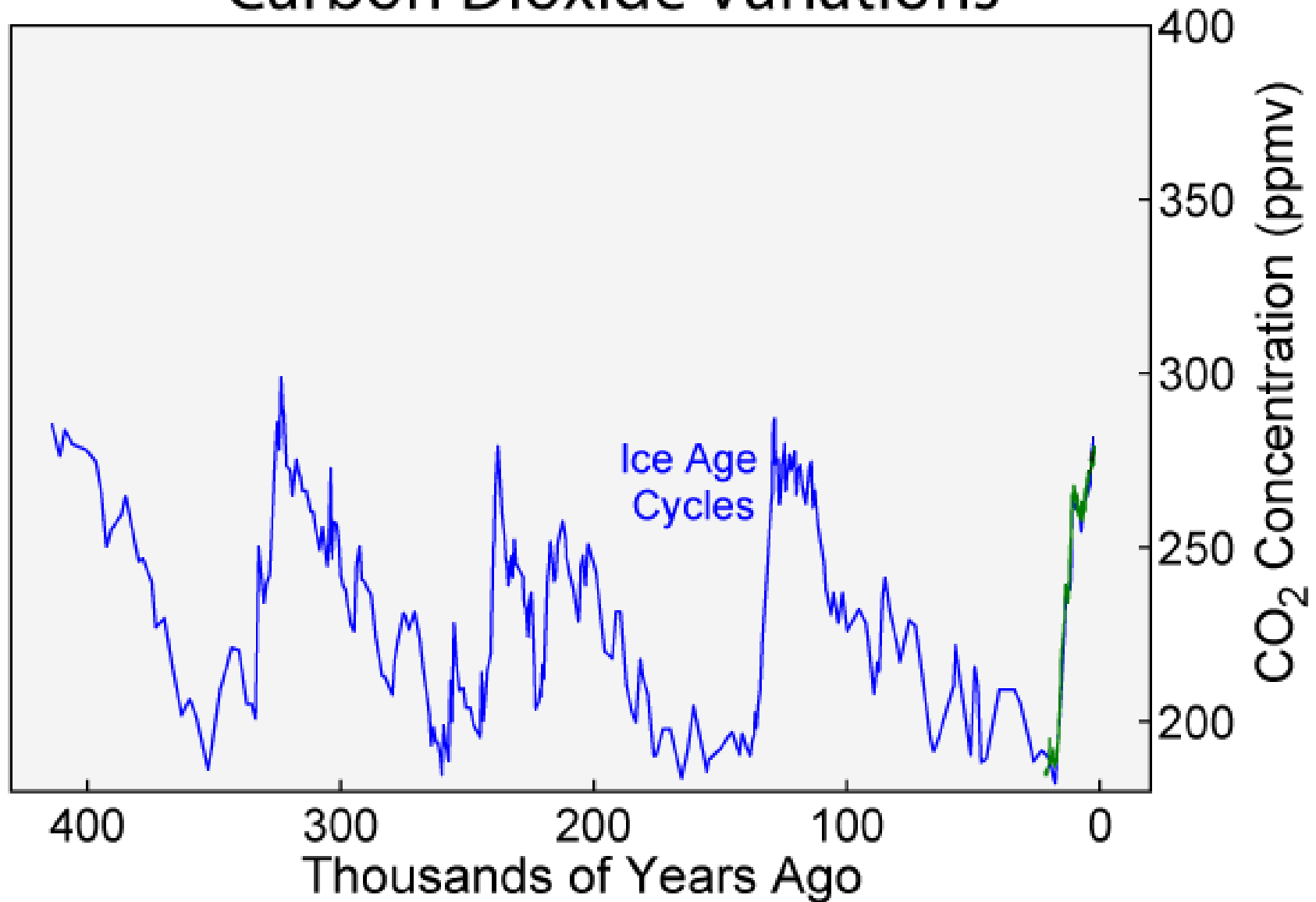
# Outline

- ◆ Quick summary of climate change mechanisms and climate projections
    - Focus on global terrestrial changes
  - ◆ Ecological ramifications of these changes
  - ◆ Challenges for resource management and conservation in adapting to climate change
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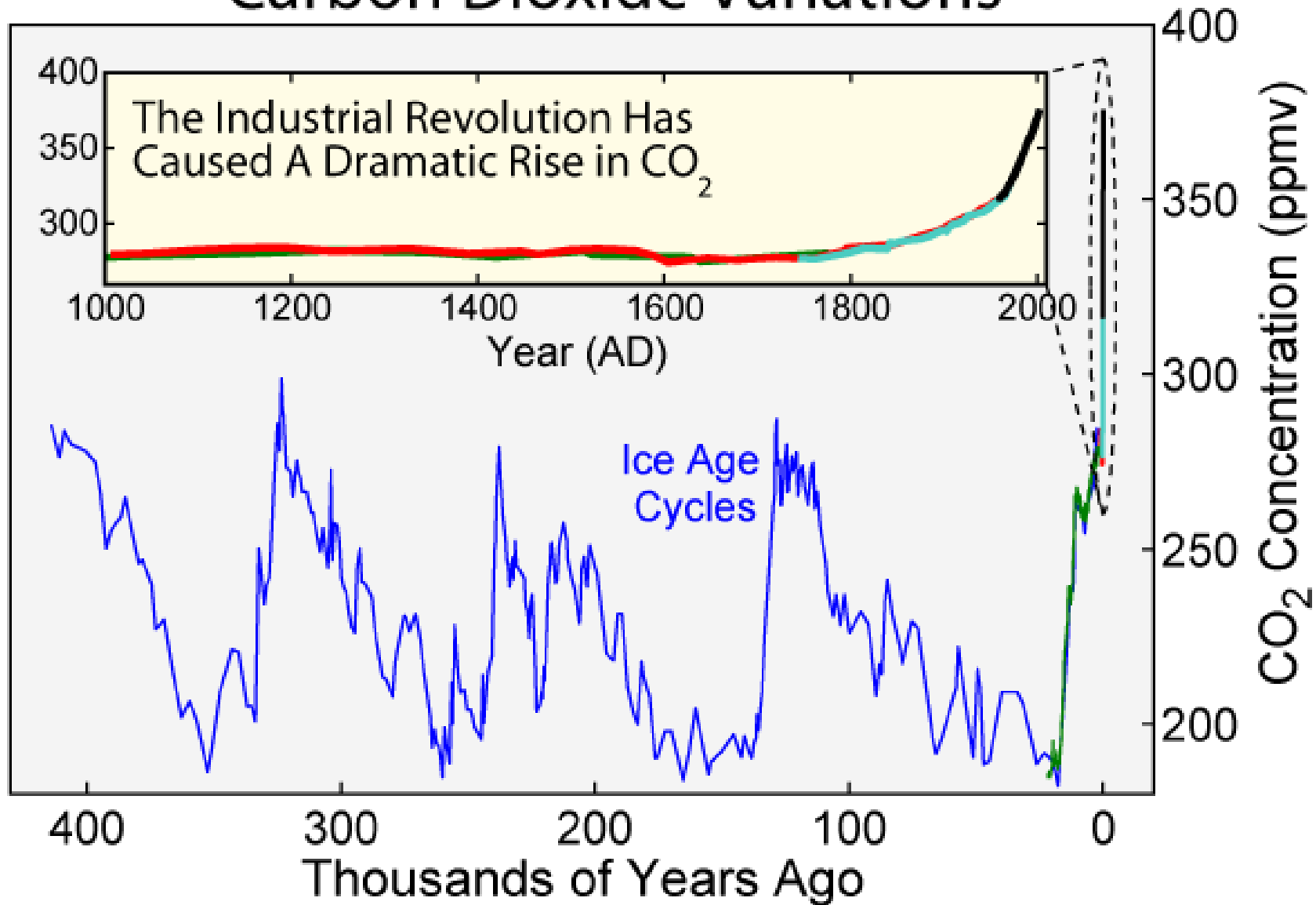
# Global Climate Change is Normal (Geologically Speaking)



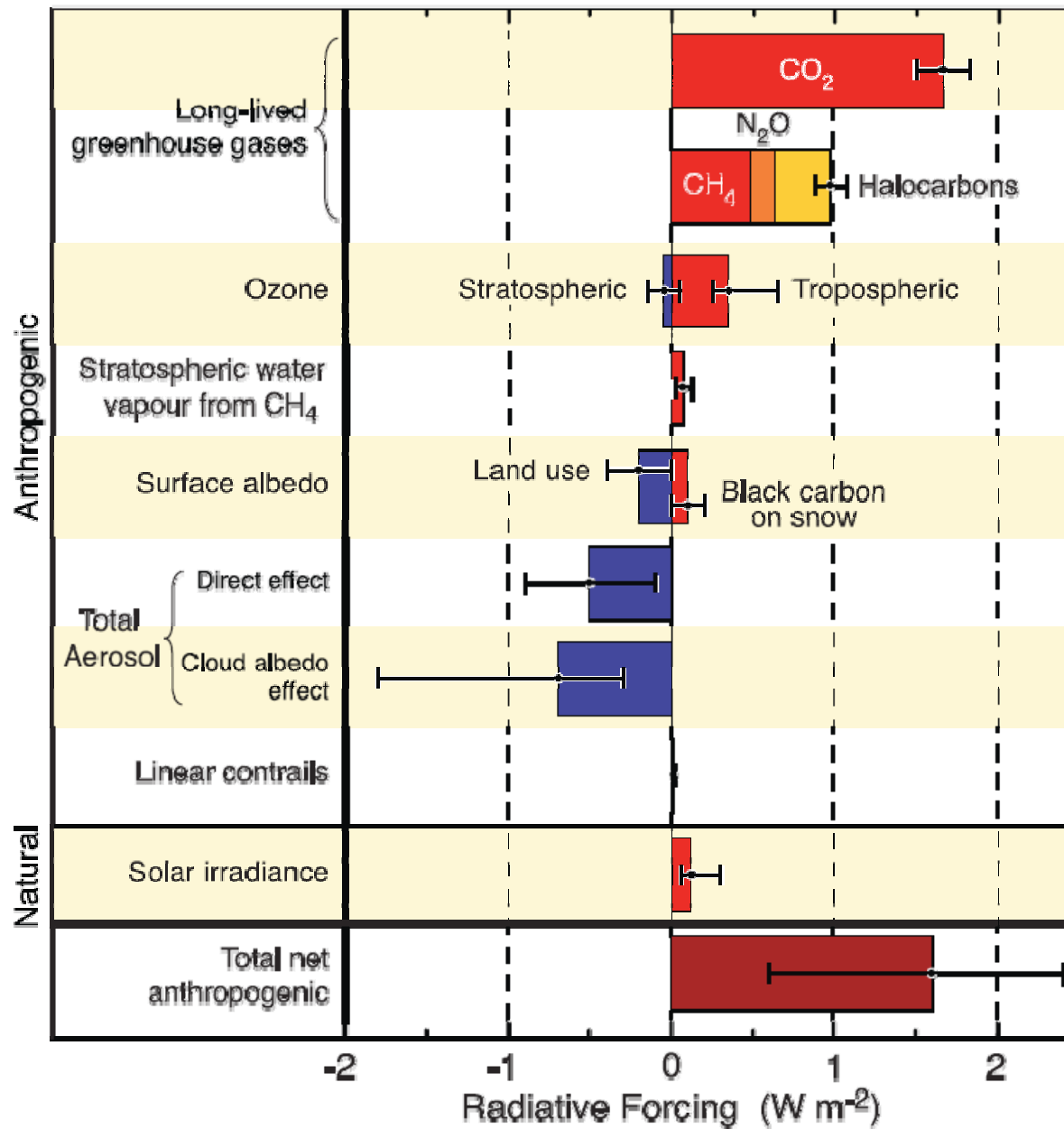
# Carbon Dioxide Variations



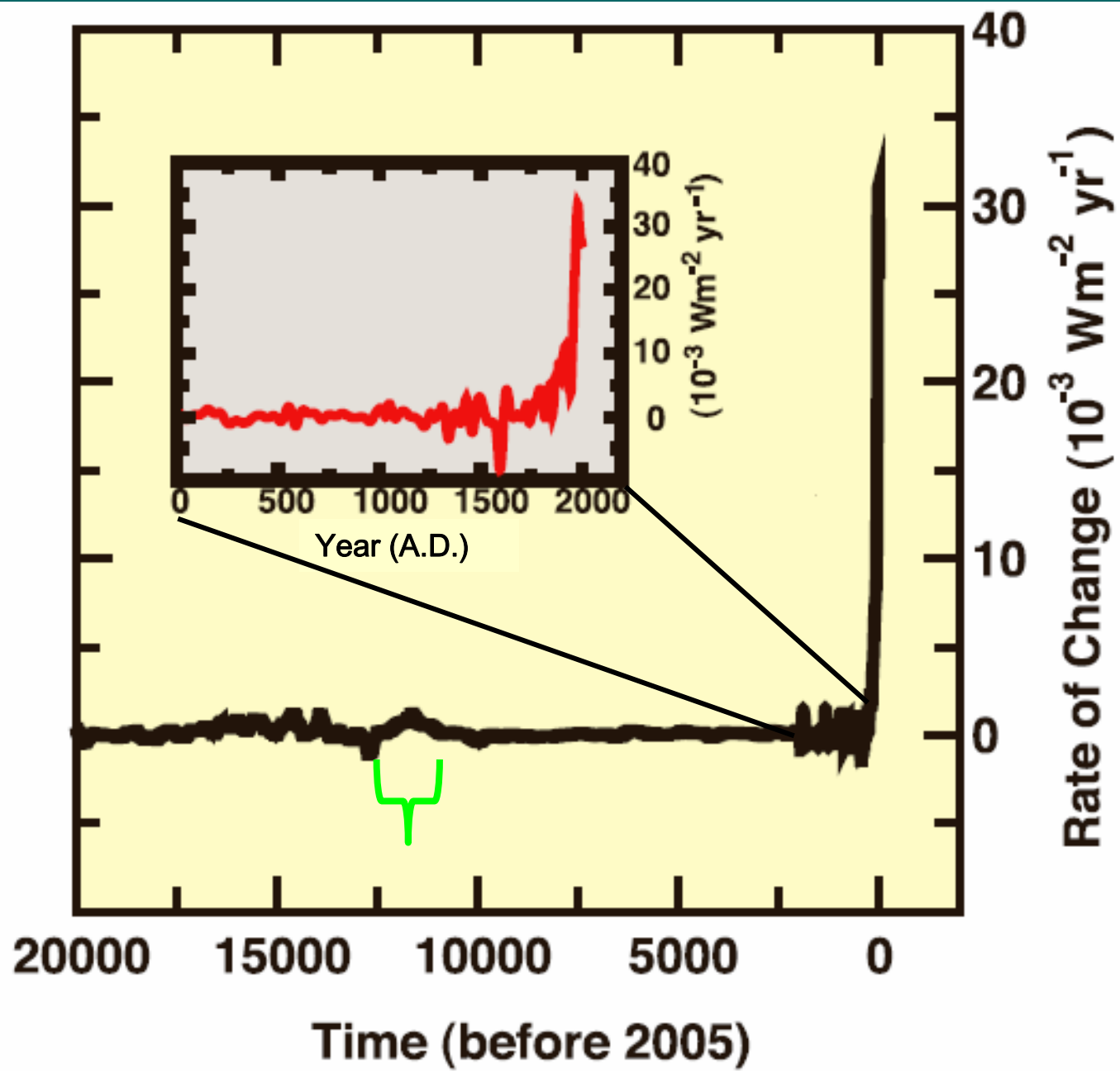
# Carbon Dioxide Variations



# Radiative Forcing Components of Global Warming



IPCC 2007

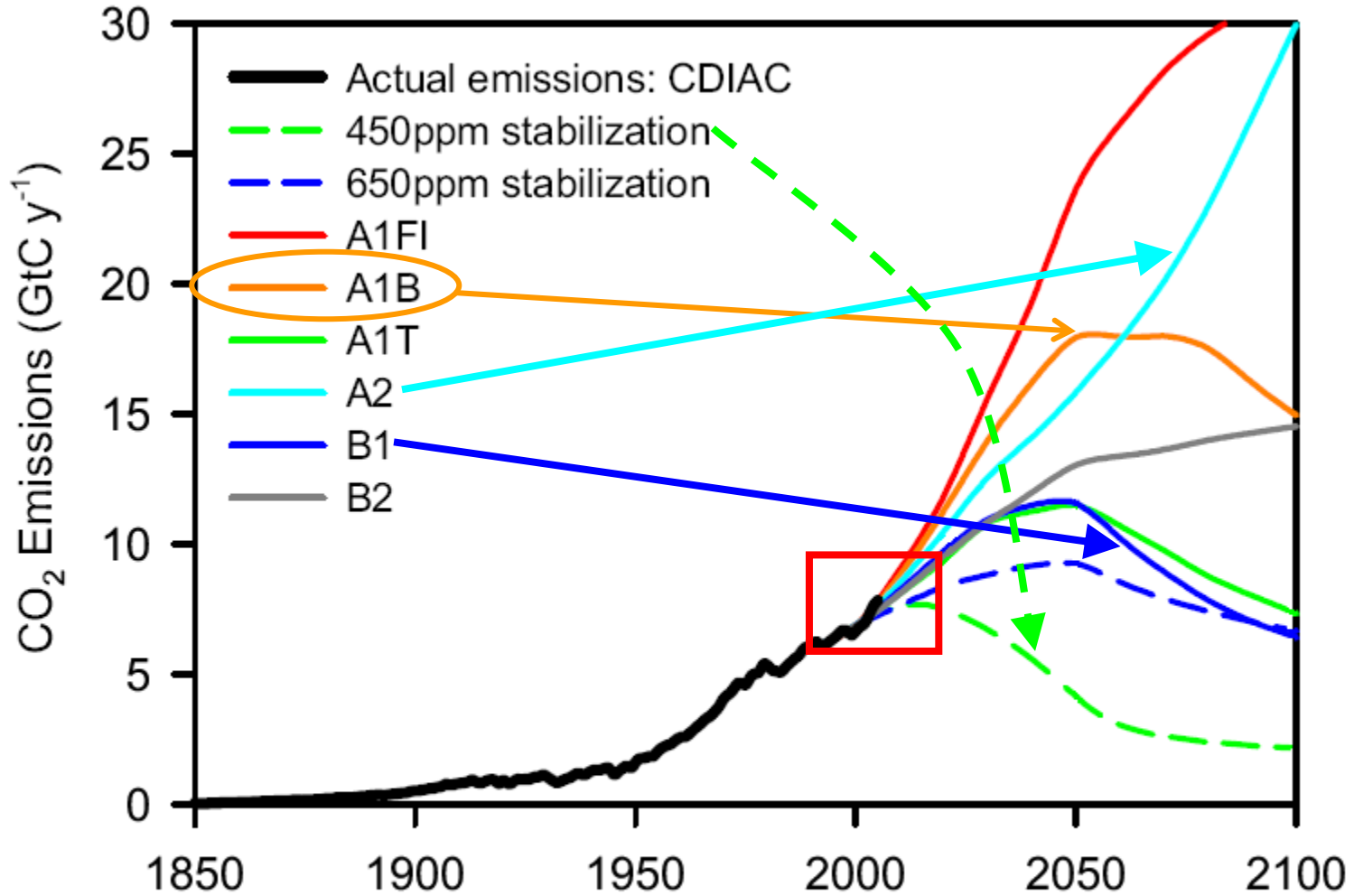


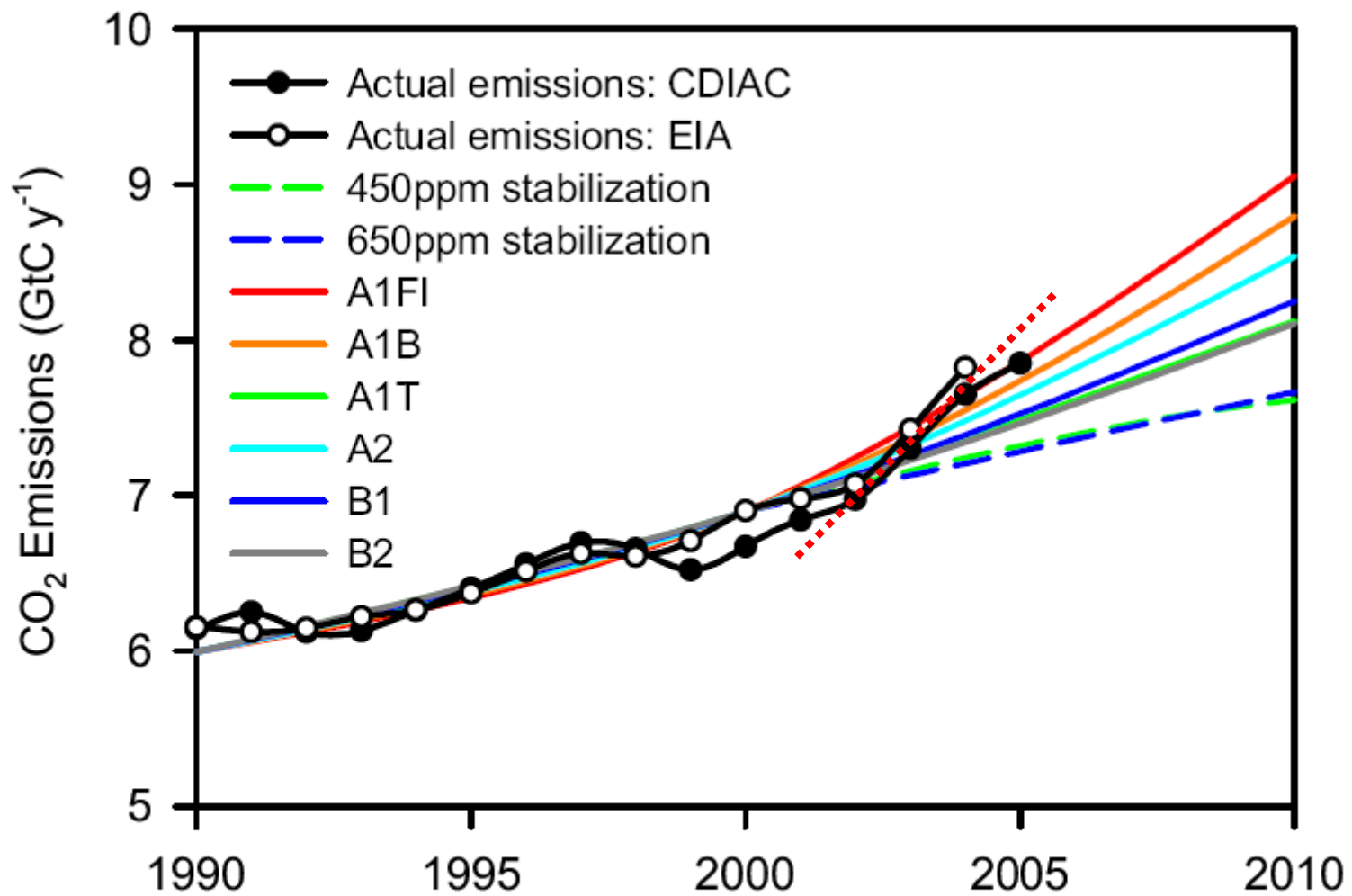
IPCC 2007

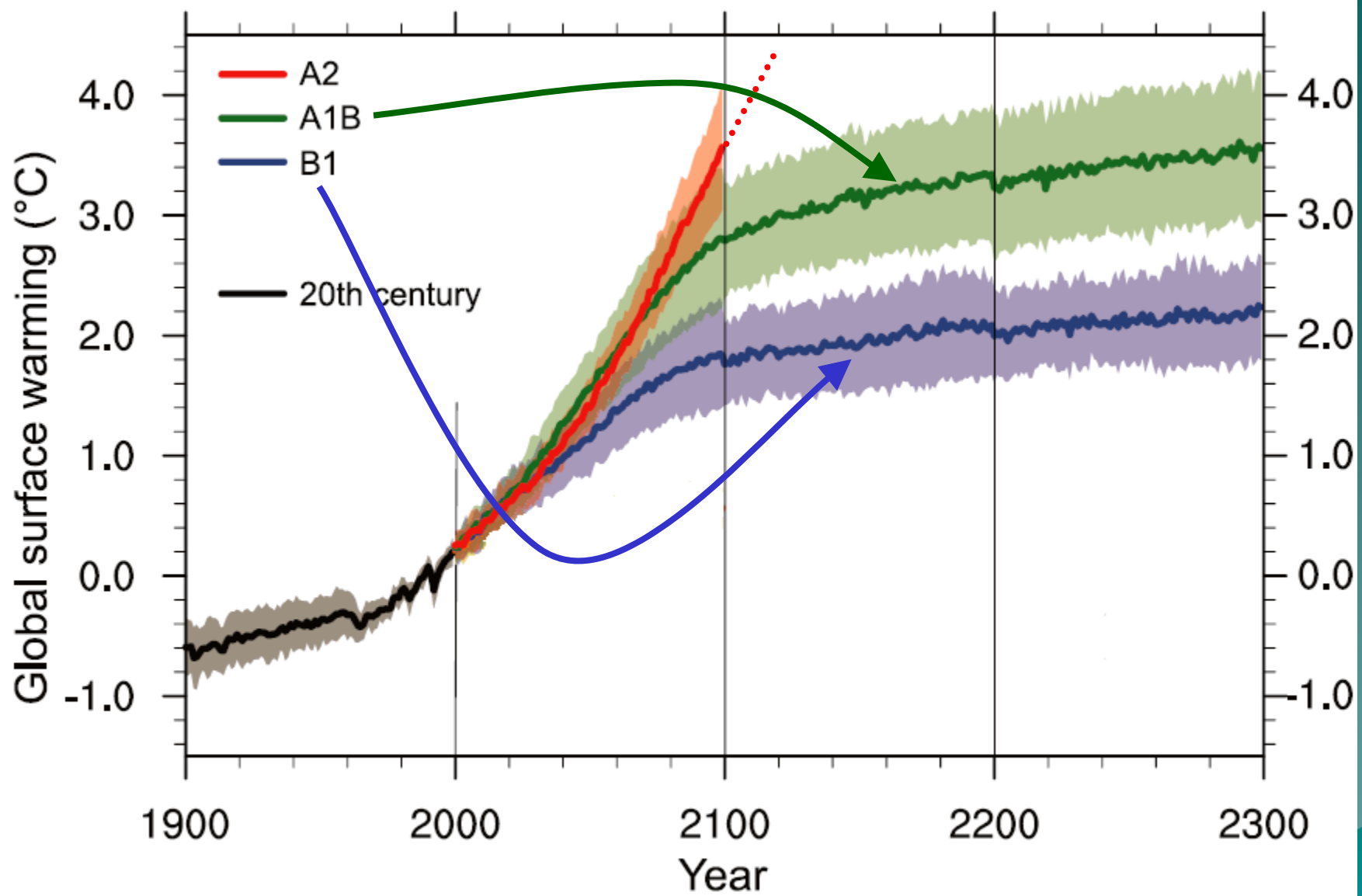
# Modern Economy = Global Warming

- ◆ Industrialization required fossil fuel, still depends upon it
- ◆ No current alternatives to satisfy demand
- ◆ The global economy is the engine of climate change
  - Growth of one = growth of other w/o changes in energy production or consumption

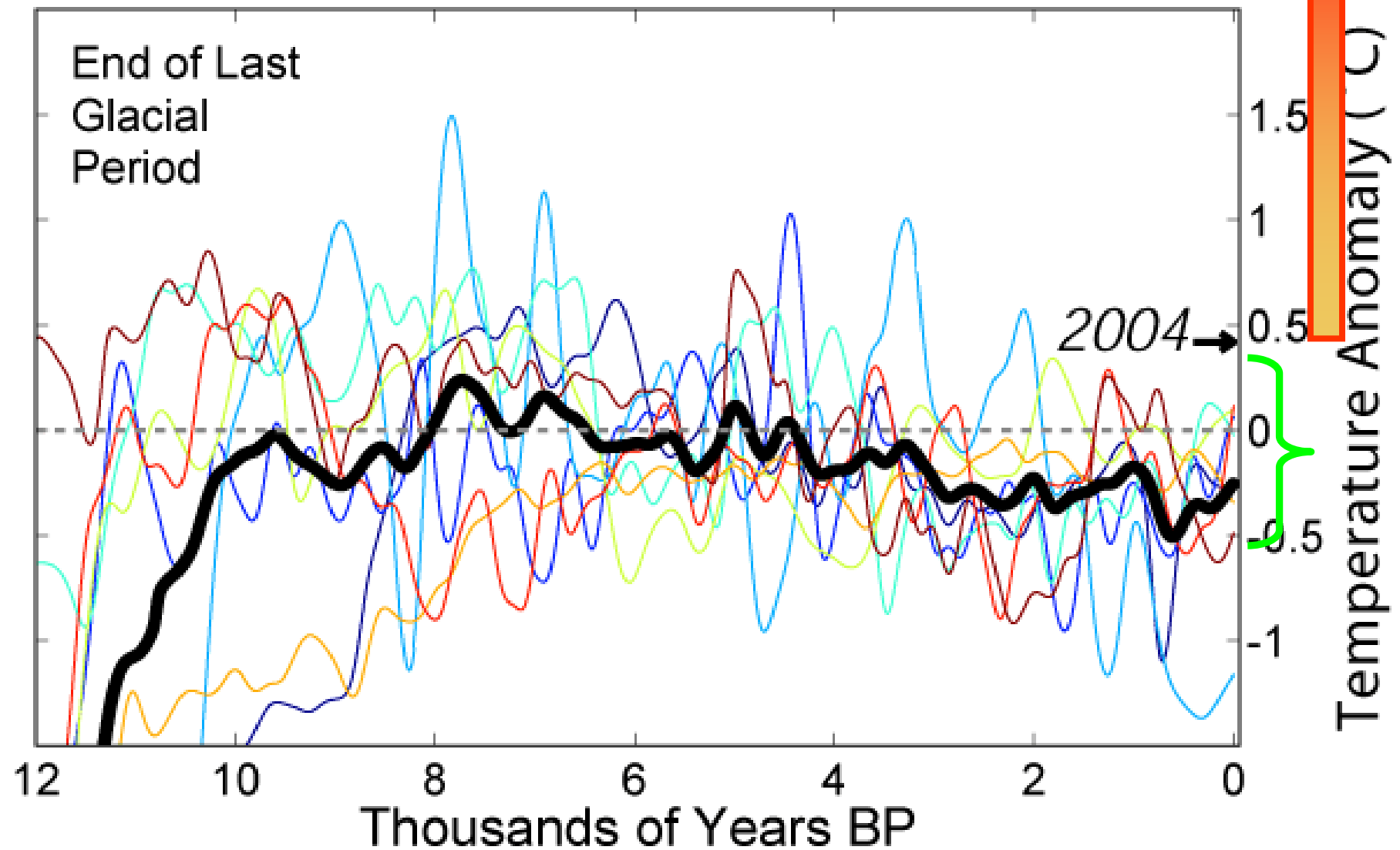








# Holocene Temperature Variations



Magnitude of response

Time taken to reach equilibrium

CO<sub>2</sub> emissions peak  
0 to 100 years

Sea-level rise due to ice melting:  
**several millennia**

Sea-level rise due to thermal  
expansion:  
**centuries to millennia**

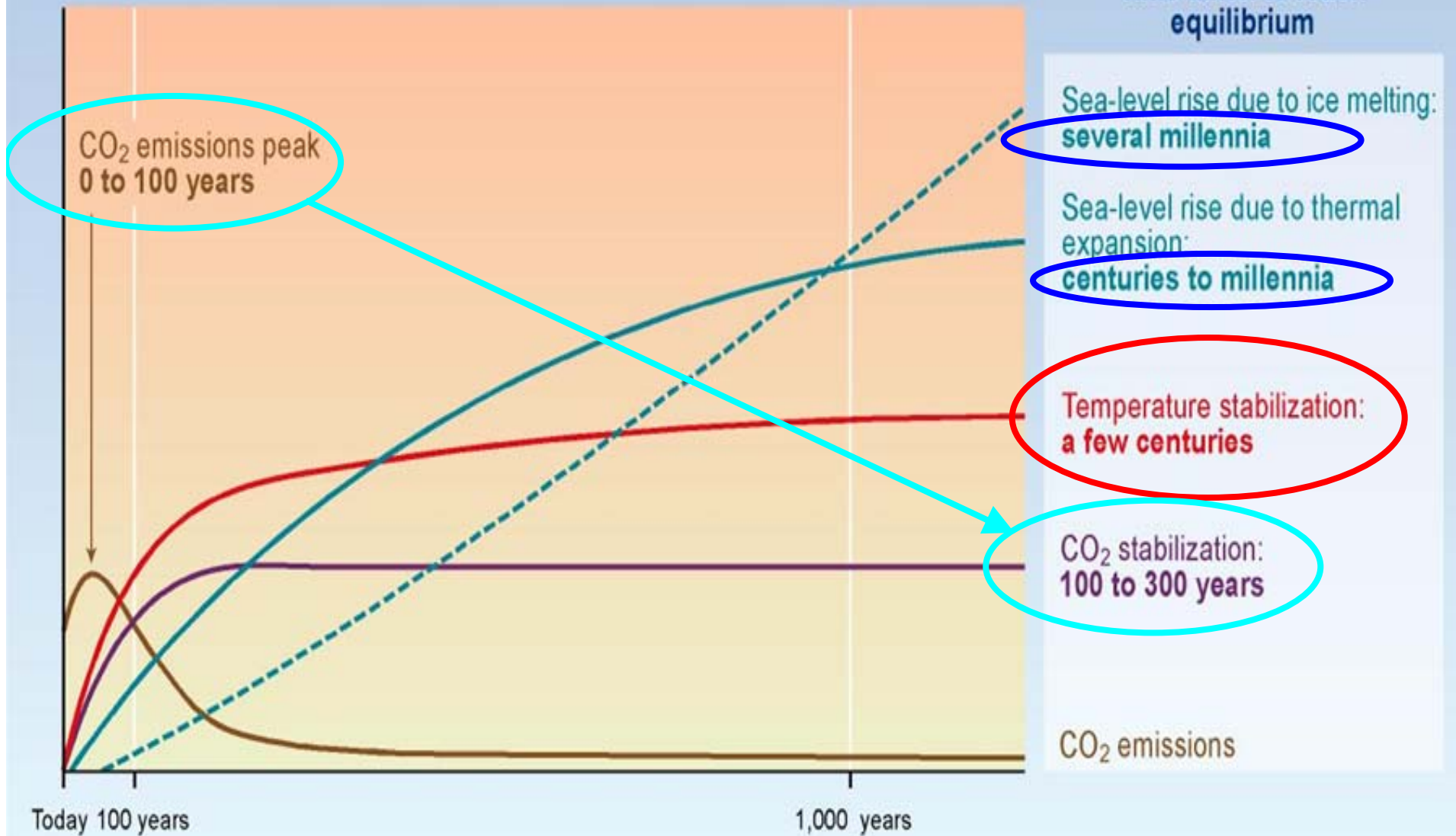
Temperature stabilization:  
**a few centuries**

CO<sub>2</sub> stabilization:  
**100 to 300 years**


CO<sub>2</sub> emissions

Today 100 years

1,000 years

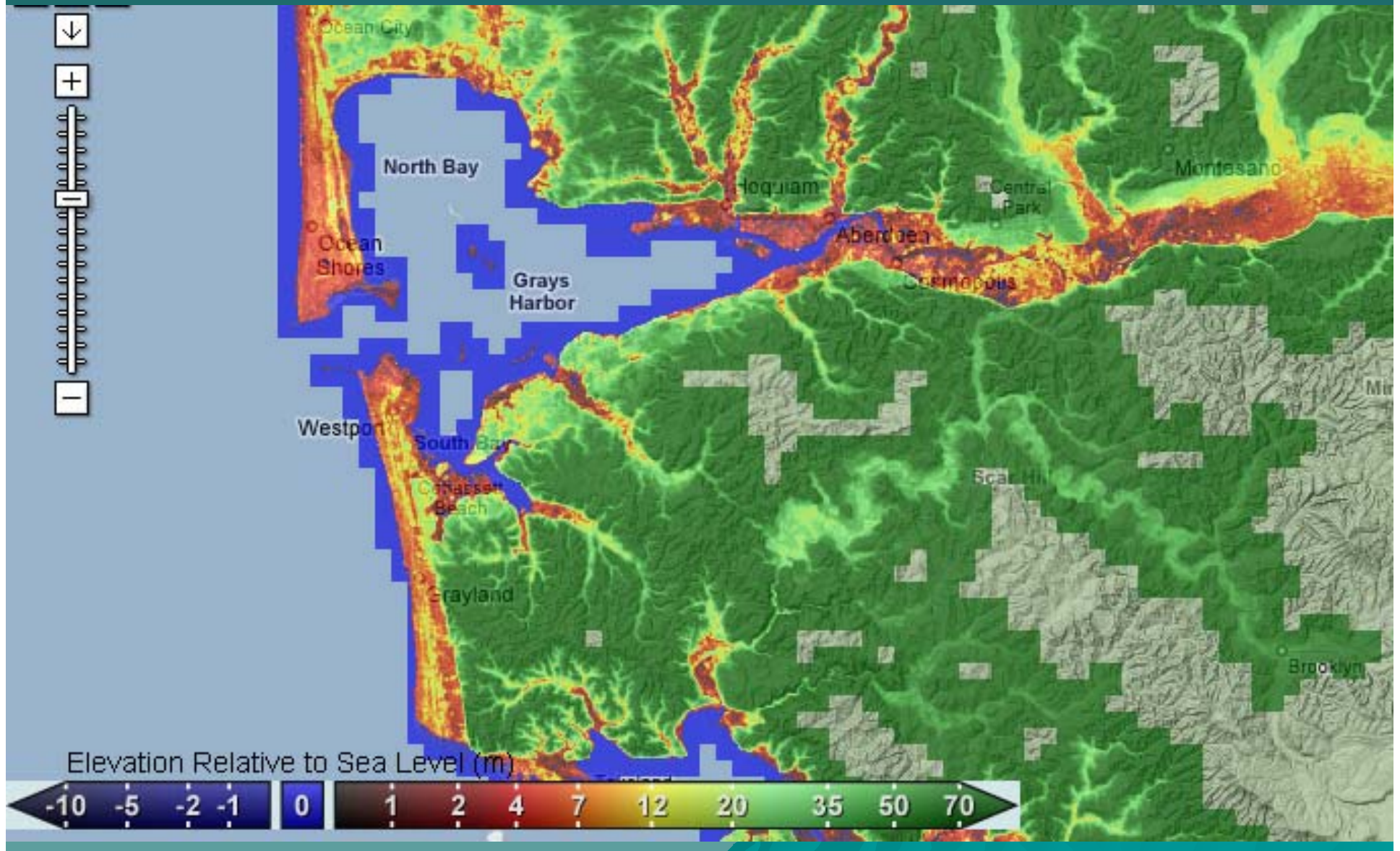


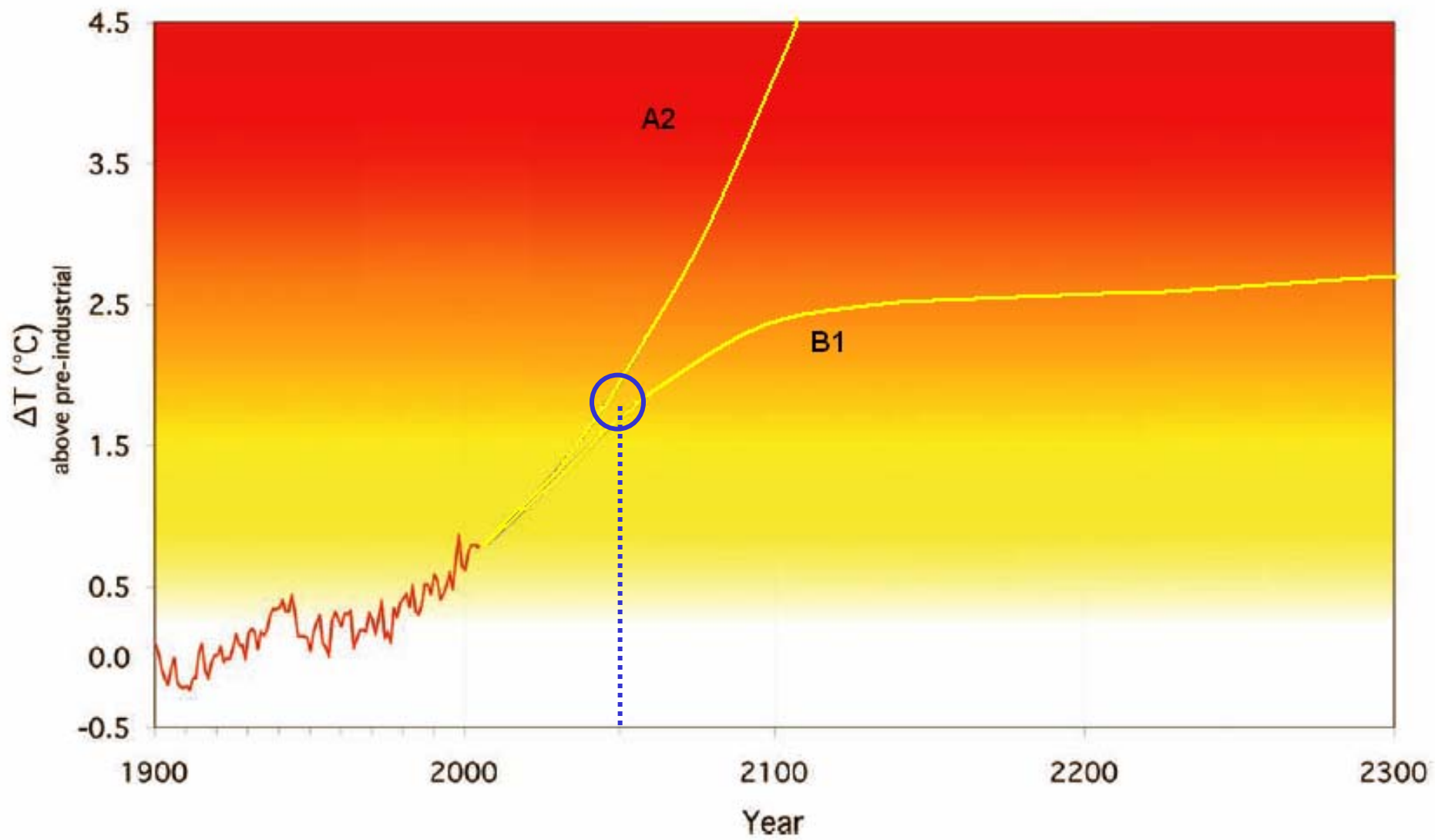
# What about sea level?

- ◆ Uncertainty in how ice caps melt leads to a wide range of projections
  - ◆ IPCC says less than 40 cm (16") by 2100
  - ◆ Up to 100 cm (40") if other assumptions are made
  - ◆ But sea will still rise for many centuries to come
- 
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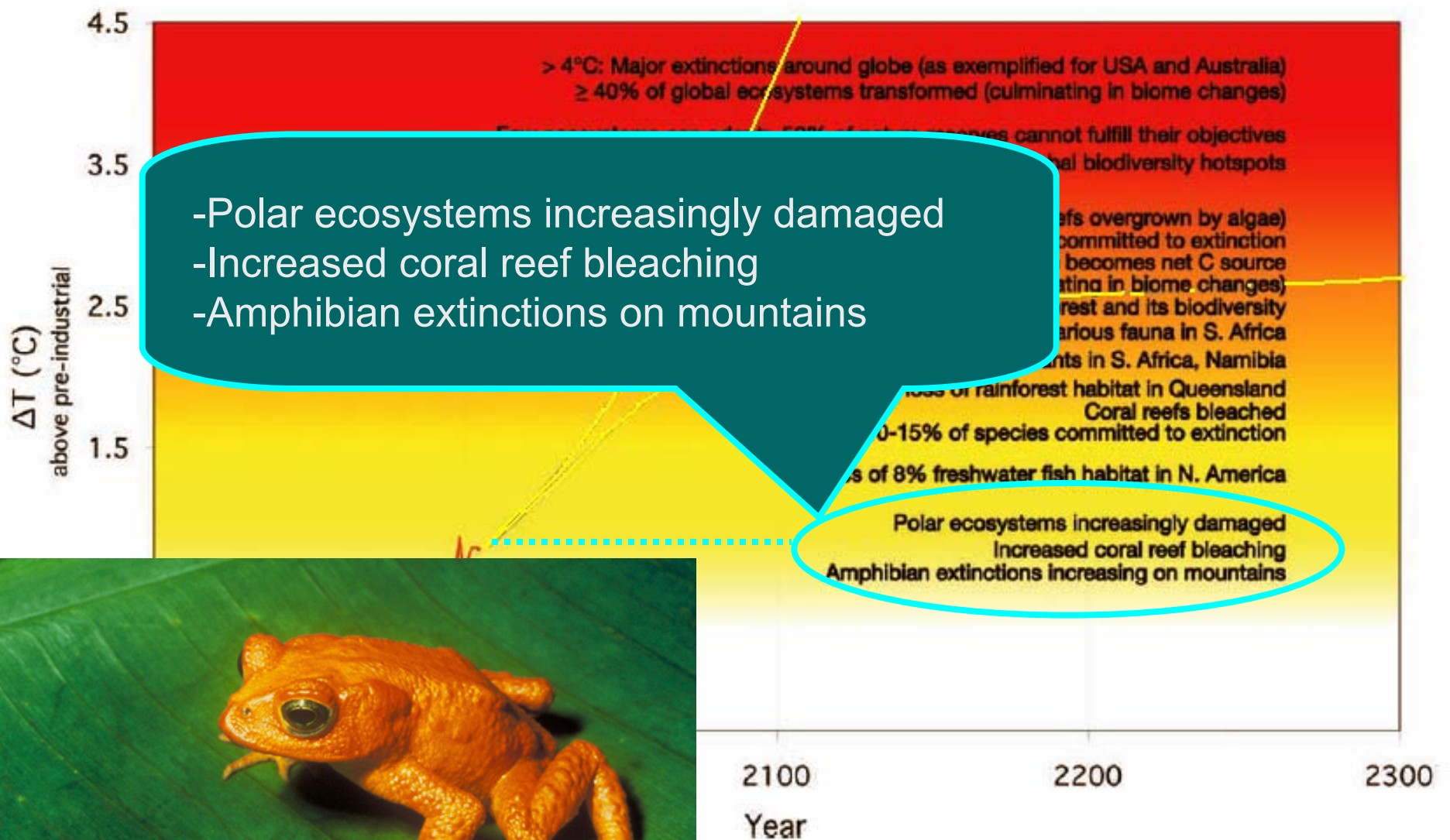


# Westport area exposure

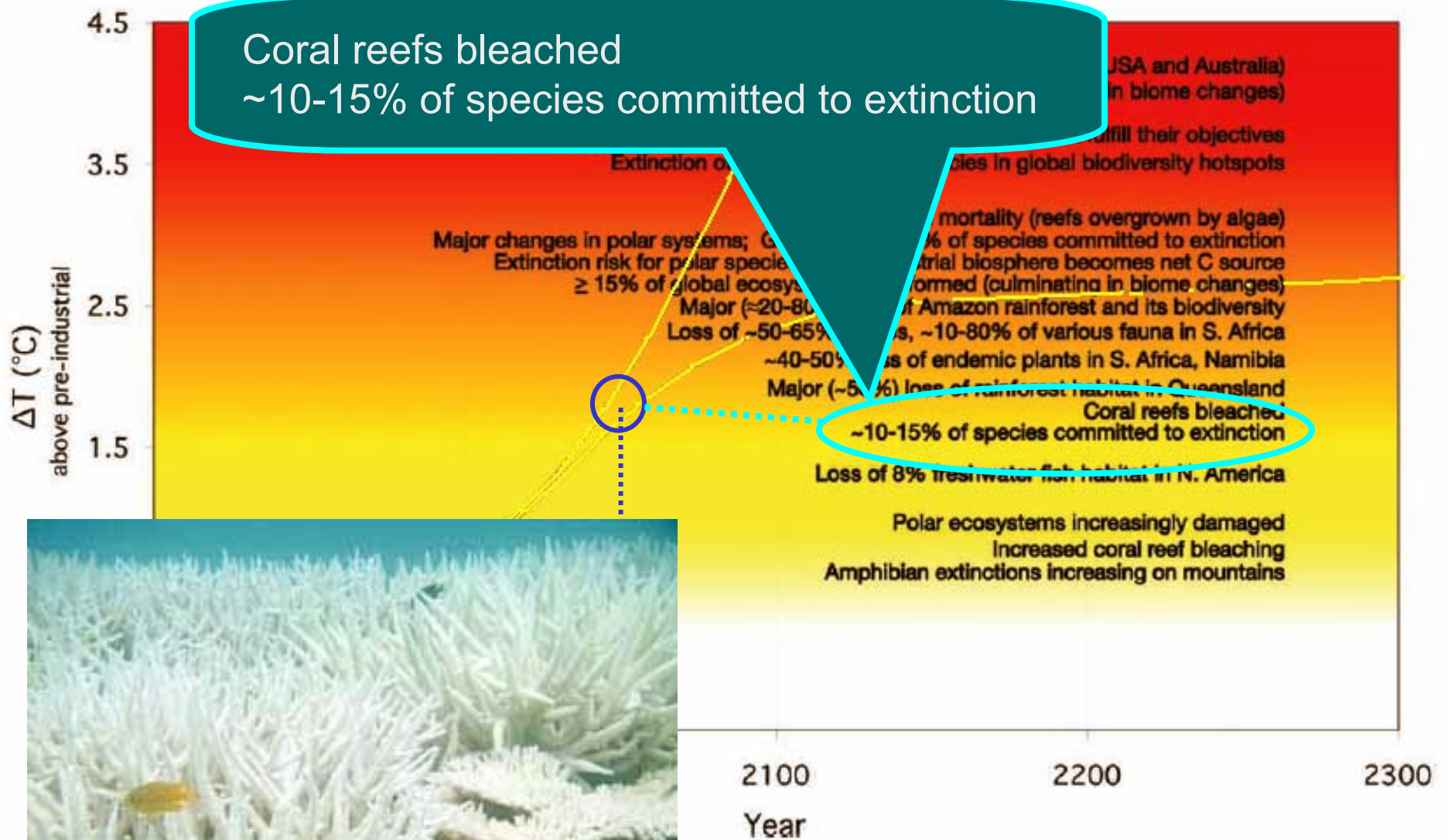






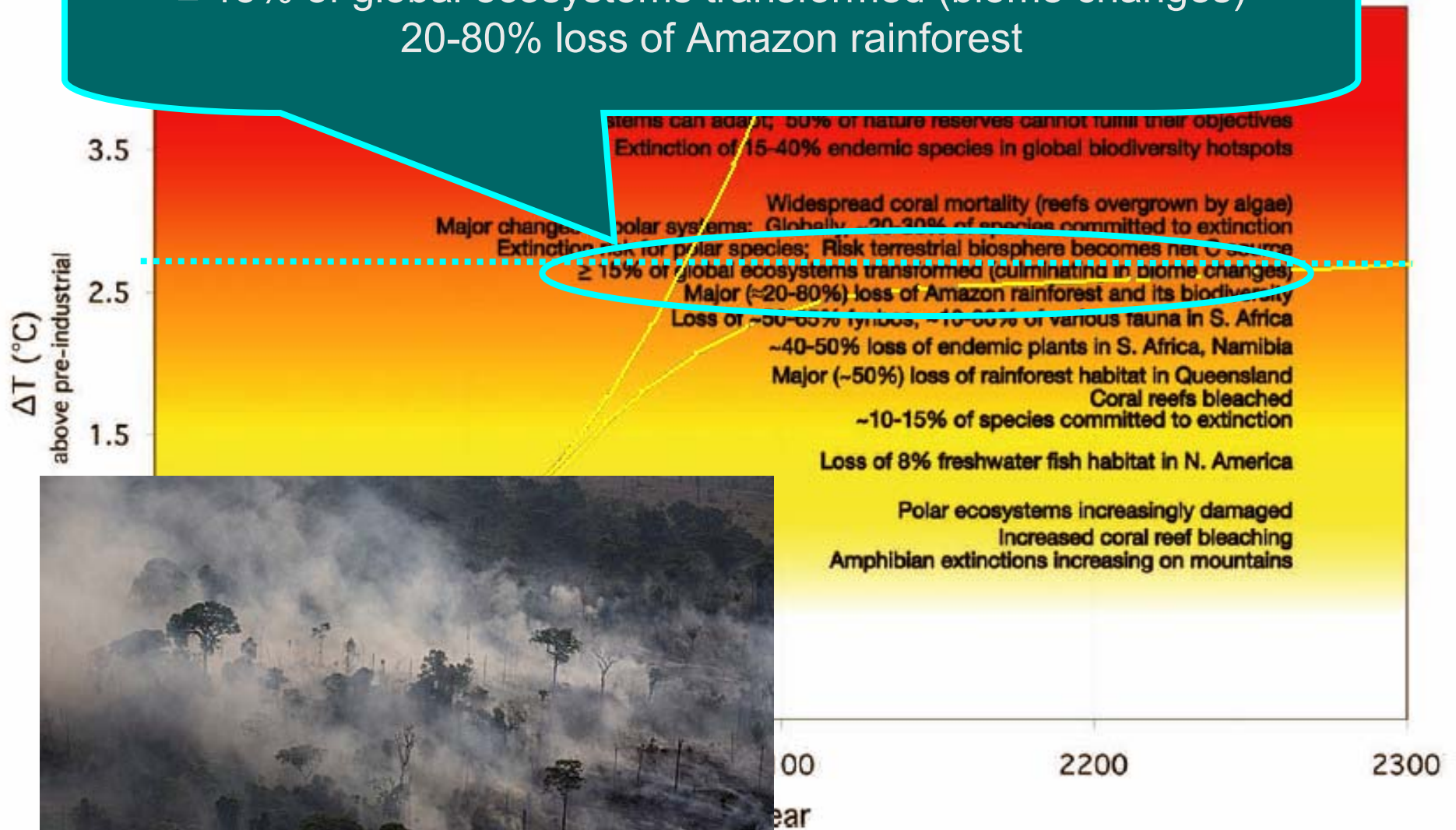


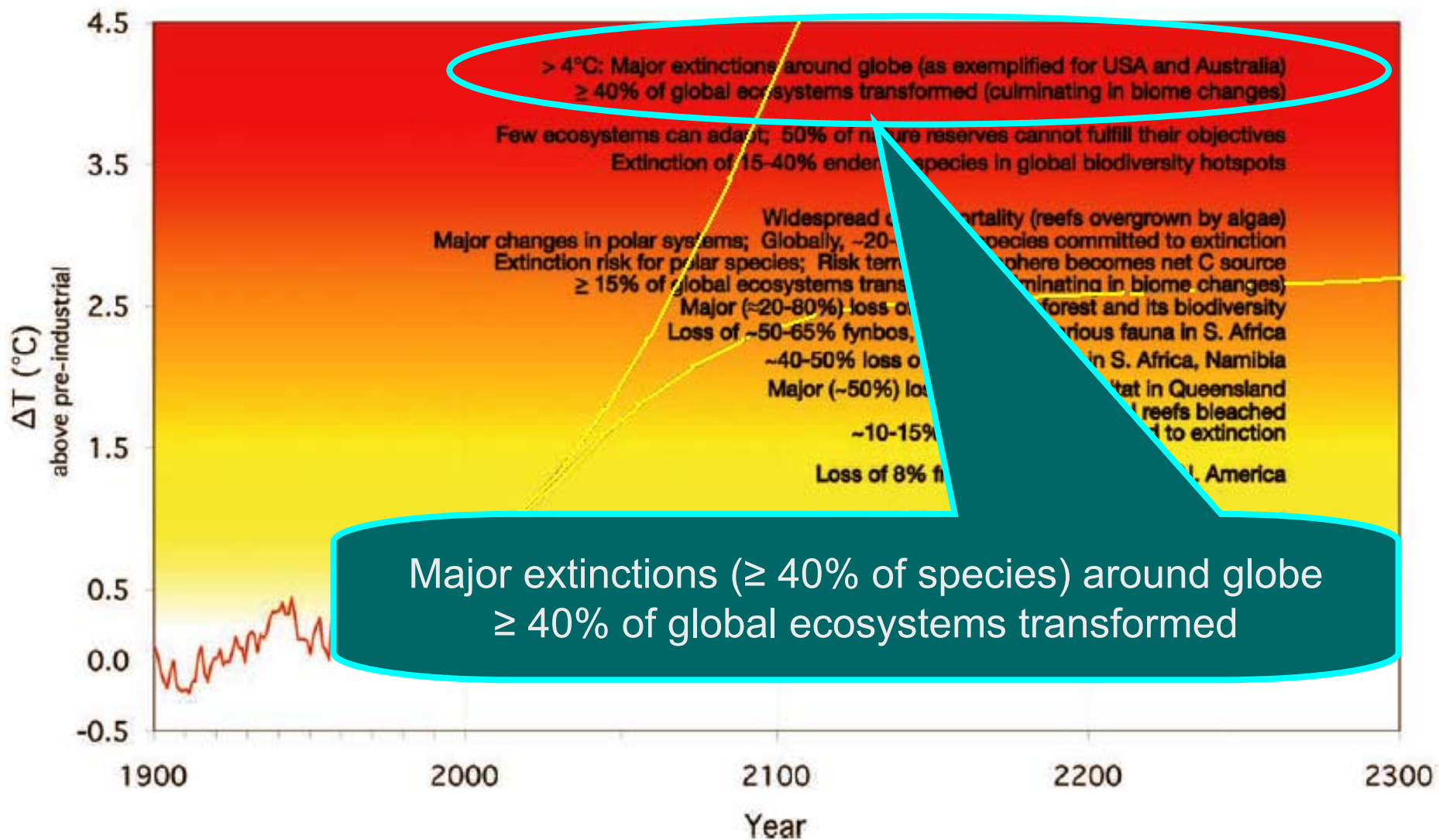
EXTINCT GOLDEN TOAD





≥ 15% of global ecosystems transformed (biome changes)  
20-80% loss of Amazon rainforest



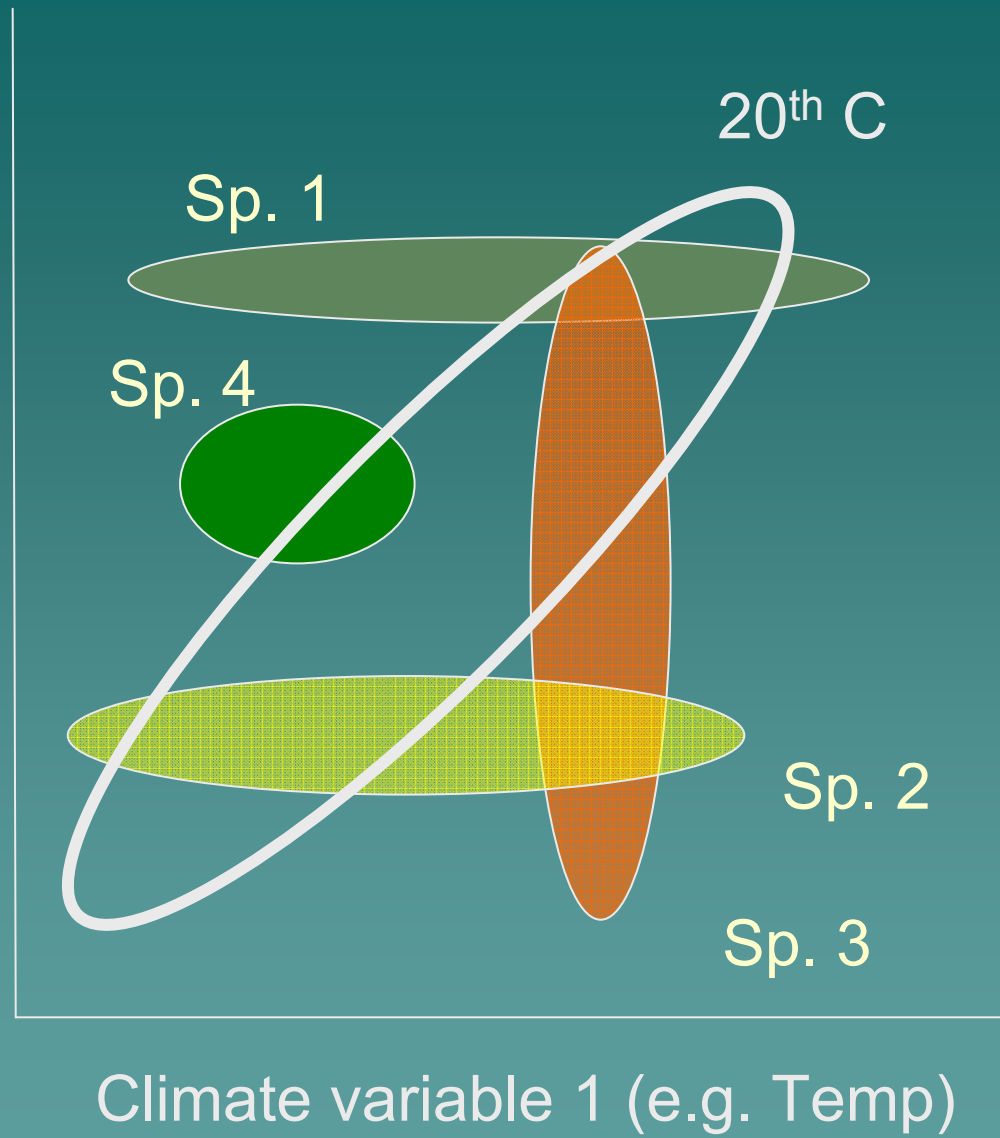


# Ecological Responses

- ◆ Change globally, react locally
- ◆ Two questions need answers
  - What will happen to the climate in a given region?
  - How will species respond?

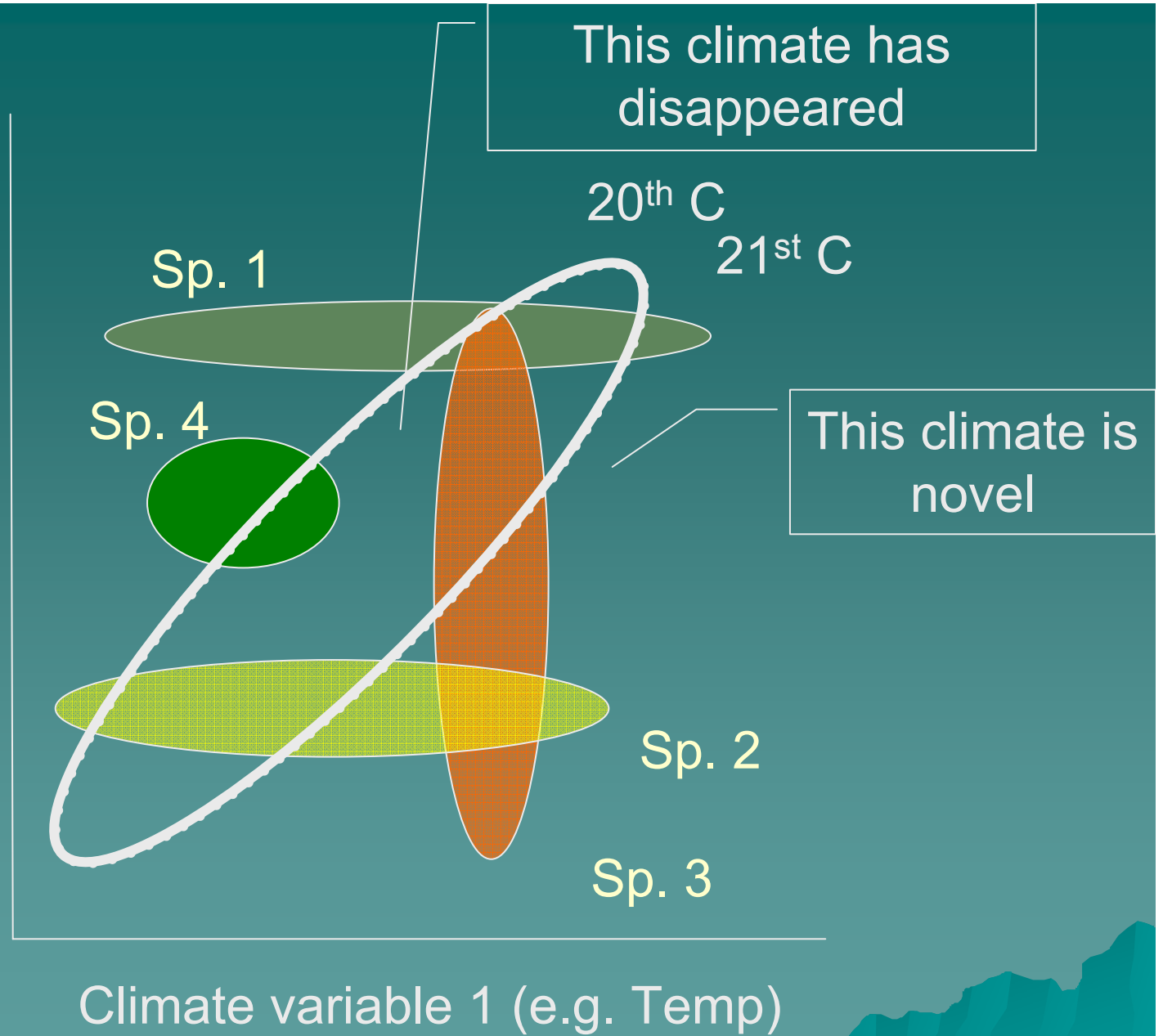


Climate variable 2 (e.g. Rainfall)

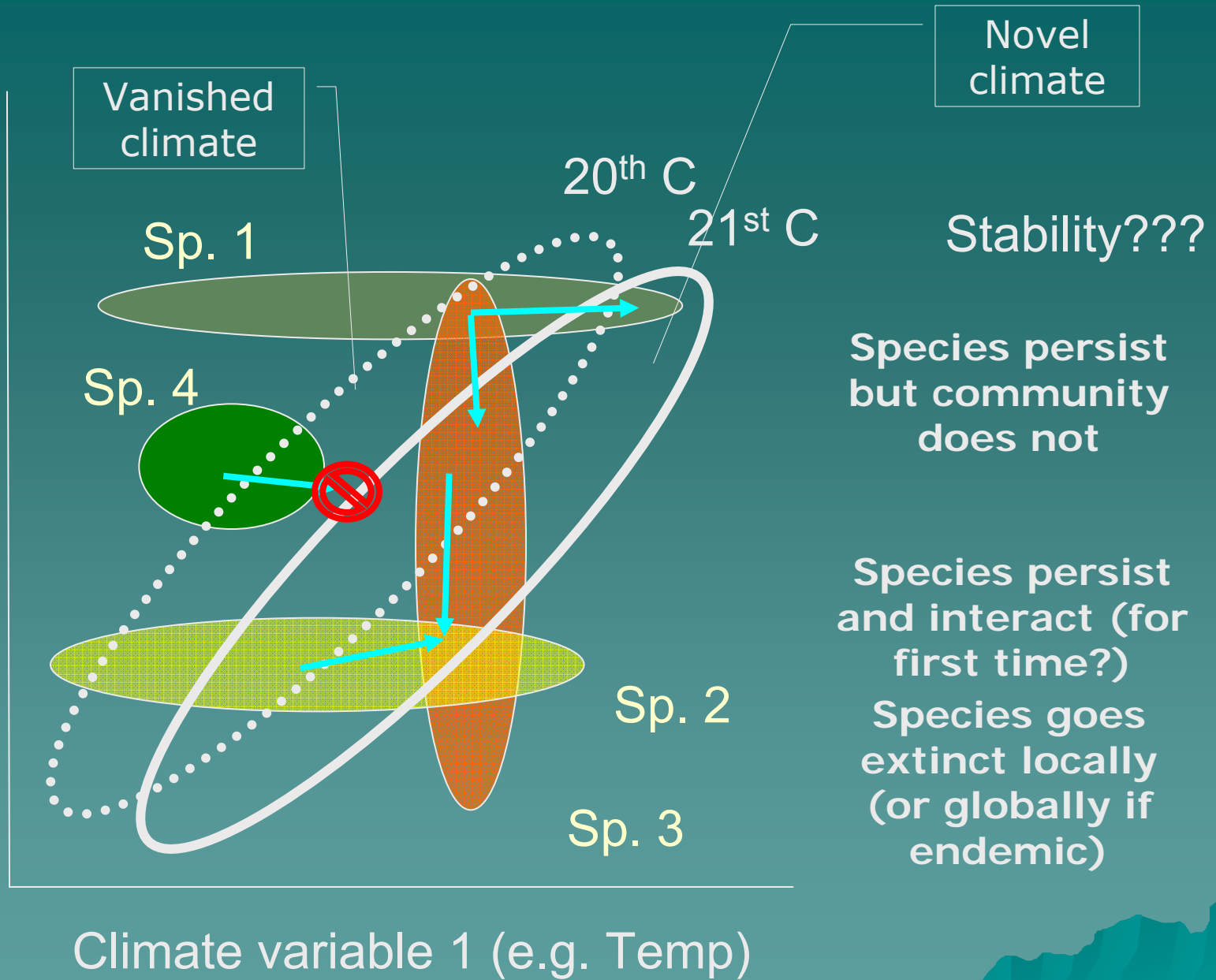


Climate variable 1 (e.g. Temp)

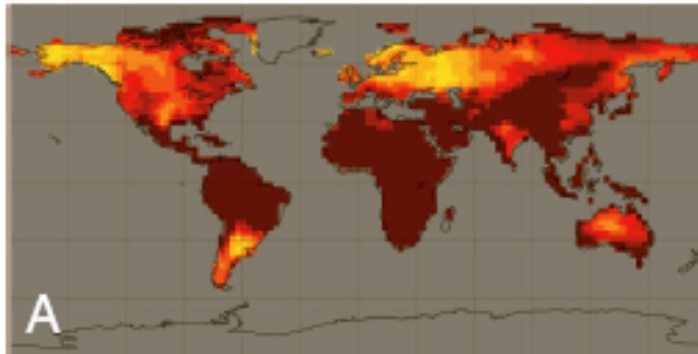
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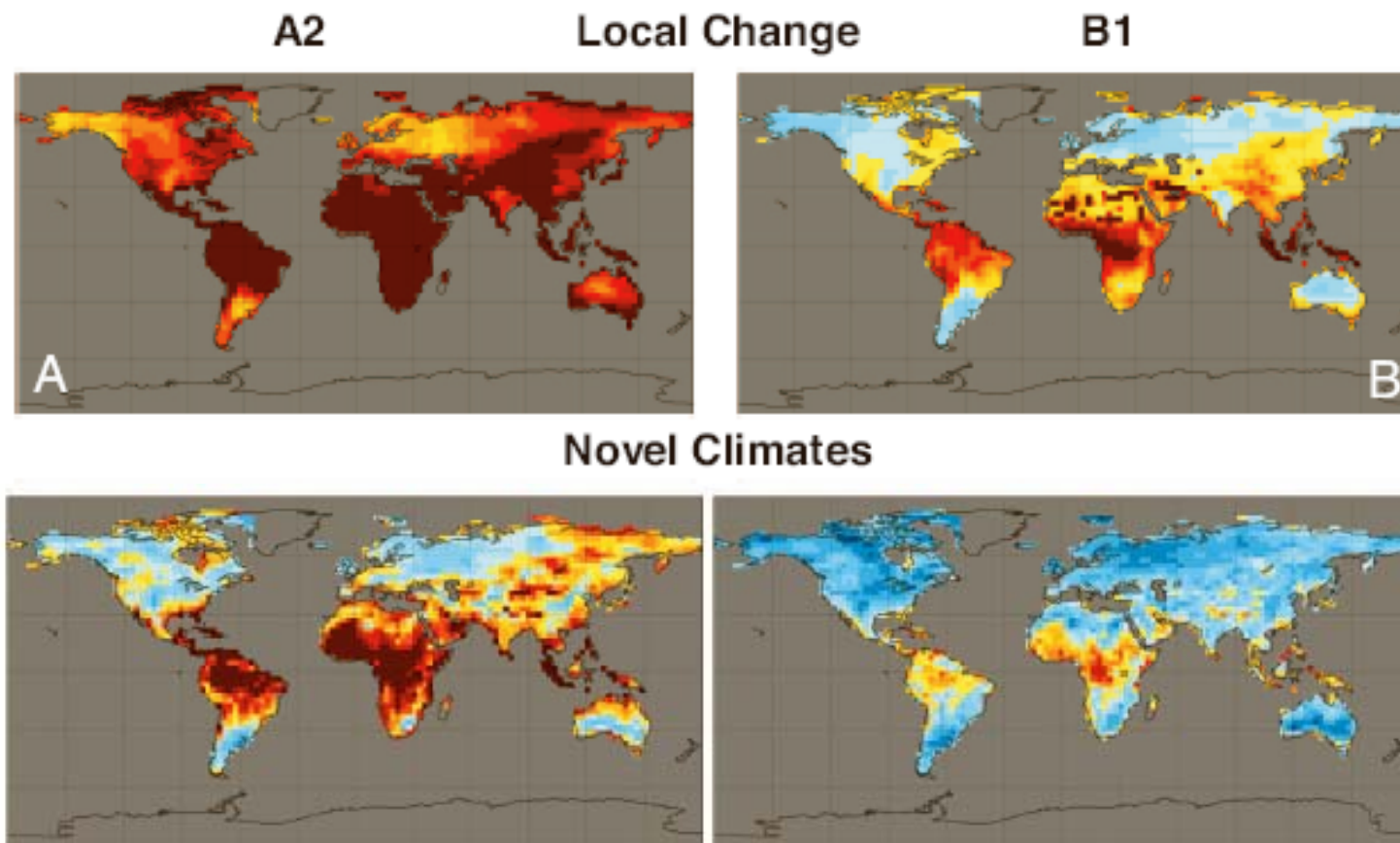
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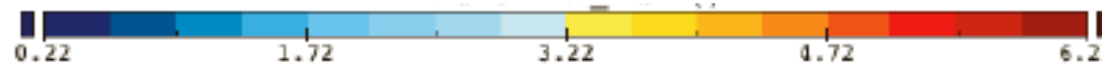


Williams et al. 2007

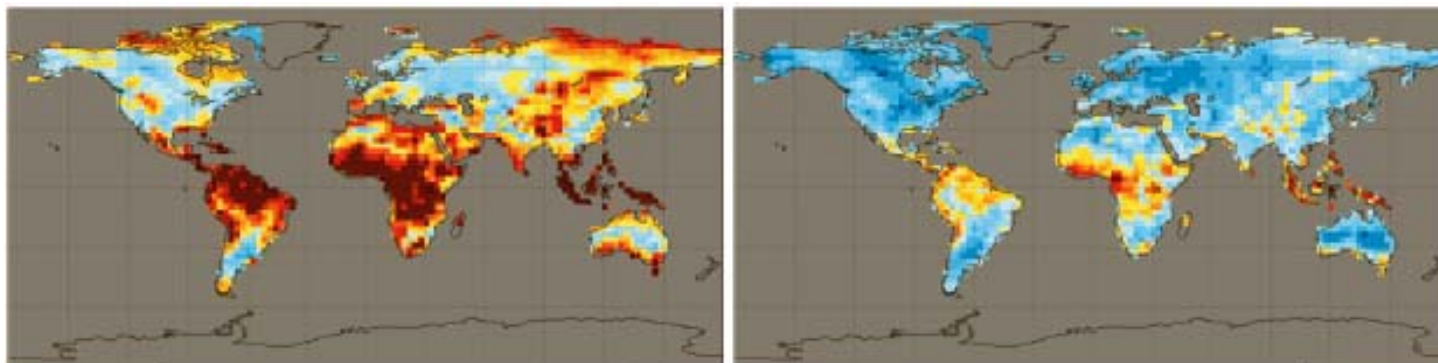
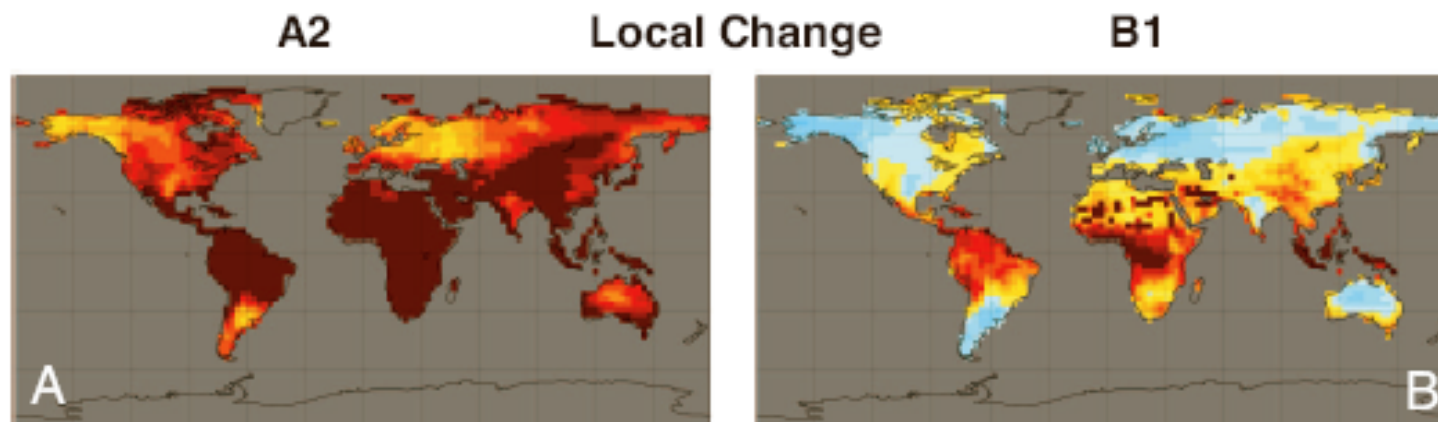


Difference of new climate from any 20<sup>th</sup> century climate within 500 km.

Hot colors are likely to be regionally novel climates

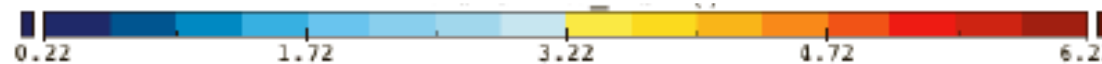


Williams et al. 2007



Difference of 20<sup>th</sup> century climate from any 21<sup>st</sup> century climate within 500 km.

Hot colors are likely to be climates that have disappeared from the region.



Williams et al. 2007

# Shifting the Conservation Paradigm

- ◆ Due to climate change, some basic assumptions underlying conservation practice and management are no longer tenable.
  - What are they?
  - How does conservation have to change?

# History is...history

- ◆ Climate change violates conservation's key assumption: that by controlling threats in a species' historical range, the species can recover and persist where it used to live
  - Underlies virtually all conservation and recovery actions
  - Global change is permanent, continuous and beyond local control
  - Historical range will lose relevance
  - If not there, where?

# You never step in the same river twice

- ◆ In adaptive management, cycles of planning-action-monitoring-planning are assumed to converge on a best solution.
  - But in a continuously changing environment, responses to land management will not converge.
  - “Communities” will start to change faster than we can learn to manage them.
  - Ecosystem management?

# Issue # 1

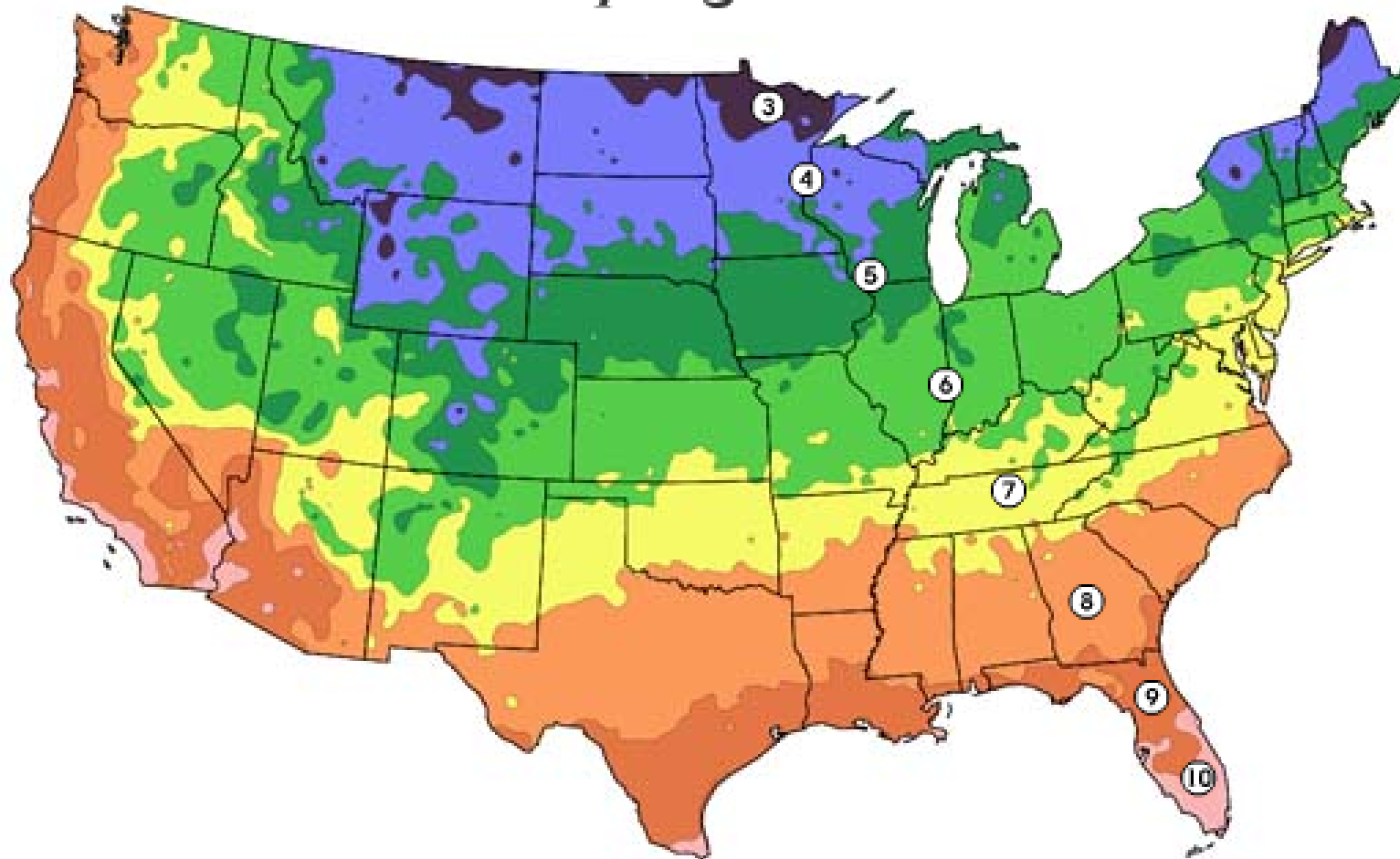
- ◆ Predictions of species' future ranges based on modeling will become fundamental to conservation planning
  - Which species?
  - What time horizon?
  - No expectation of future equilibrium
  - Tools need rapid development
- ◆ Institutionalized collaborations, with funding for modeling

## Issue # 2

- ◆ How to manage lands to maximize species' survival as ecosystems change
  - Plants will move, animals will follow
  - Look south and down, north and up
  - Reduce other stresses (e.g. harvest, fire) to enhance resilience for currently resident species



## 2006 arborday.org hardiness zones



Zones



## Issue # 3

- ◆ Conflicts between desires of people vs. needs of wild species will escalate as climate crises become more frequent and severe
  - Dealing with impacts to people, agriculture will dominate funding
  - Reframing the issue in terms of human well-being

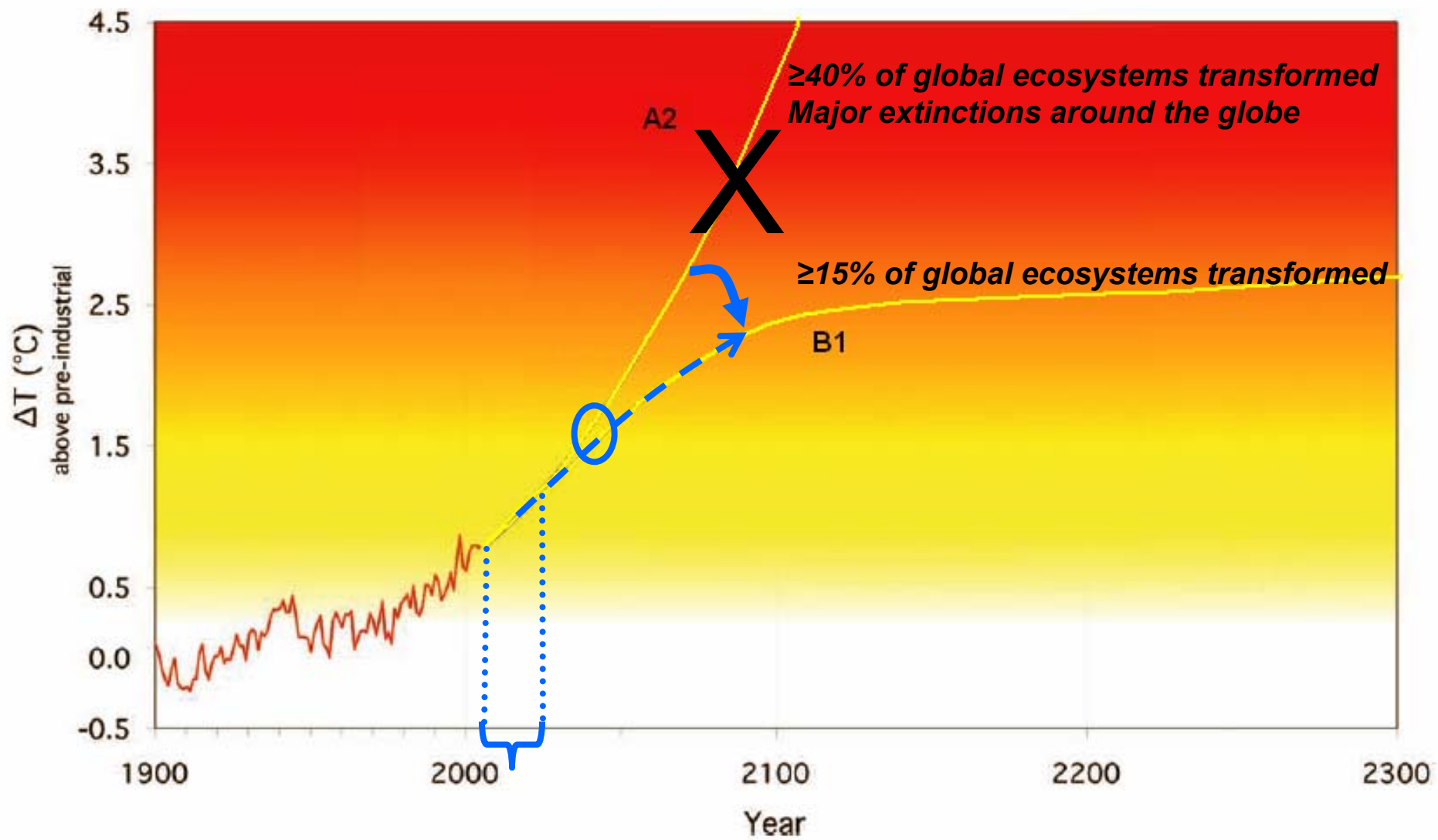
## Issue # 4

- ◆ Full awareness of the impacts of climate change can lead to despair
  - Negative emotions are normal when personal and organizational objectives are threatened by a changed reality
  - People and agencies need to focus on reasonable actions that will make a difference
  - Current goals assume a stable climate that we will never see again

# Issue # 5

- ◆ The challenge to leadership:

Developing and working towards achievable goals that incorporate rapid, fundamental change in the natural world



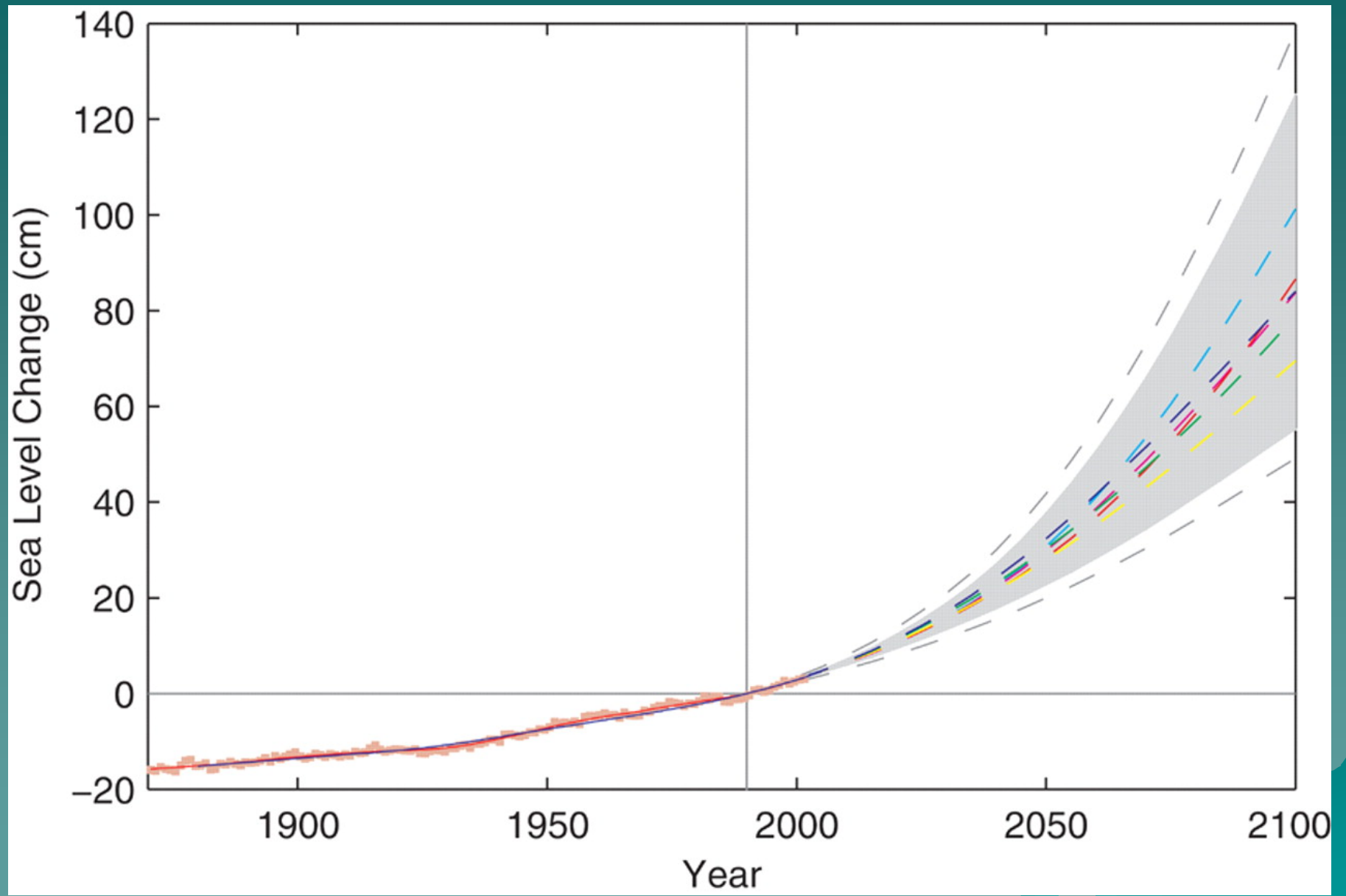


# Mahalo



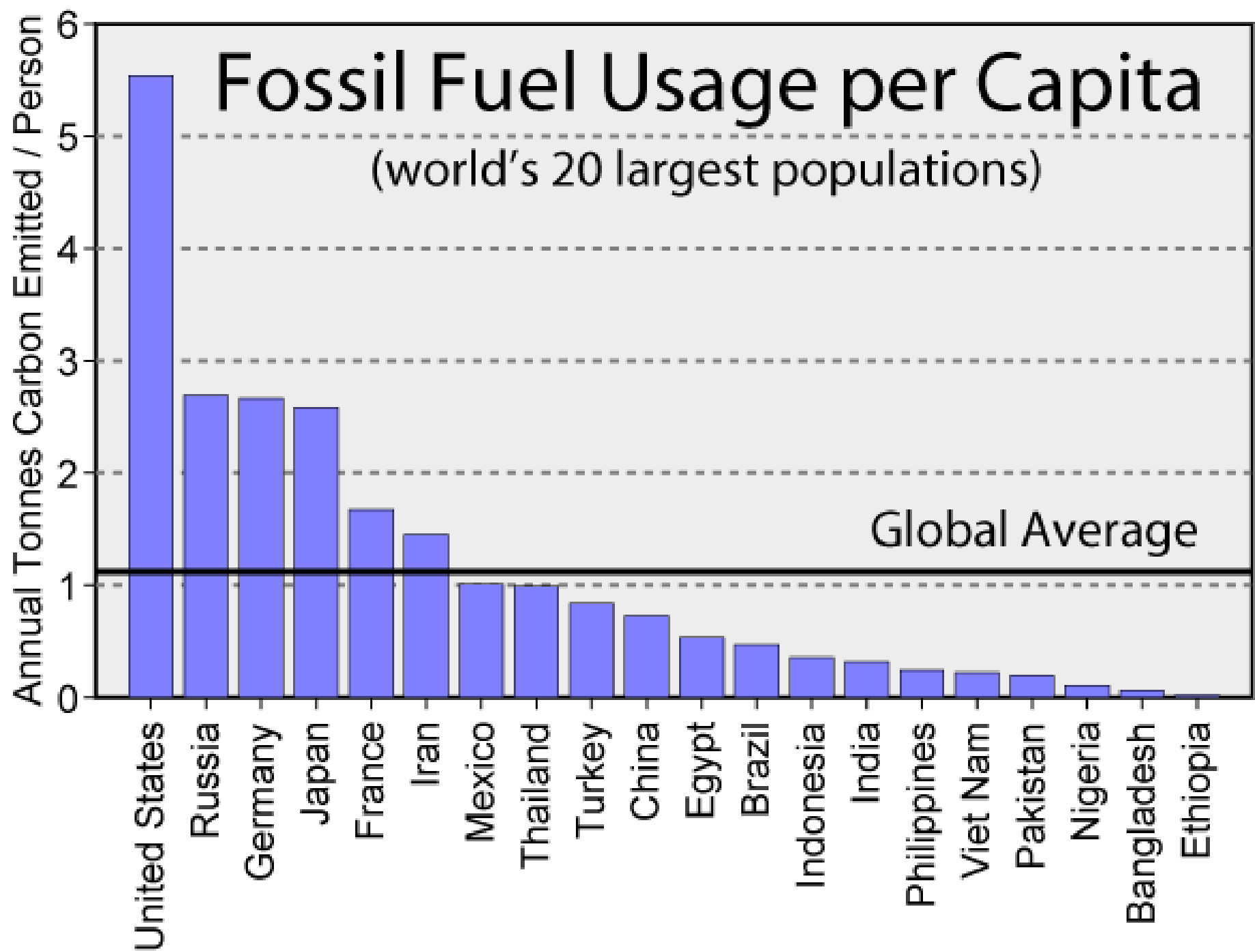
Photo © Jack Jeffrey

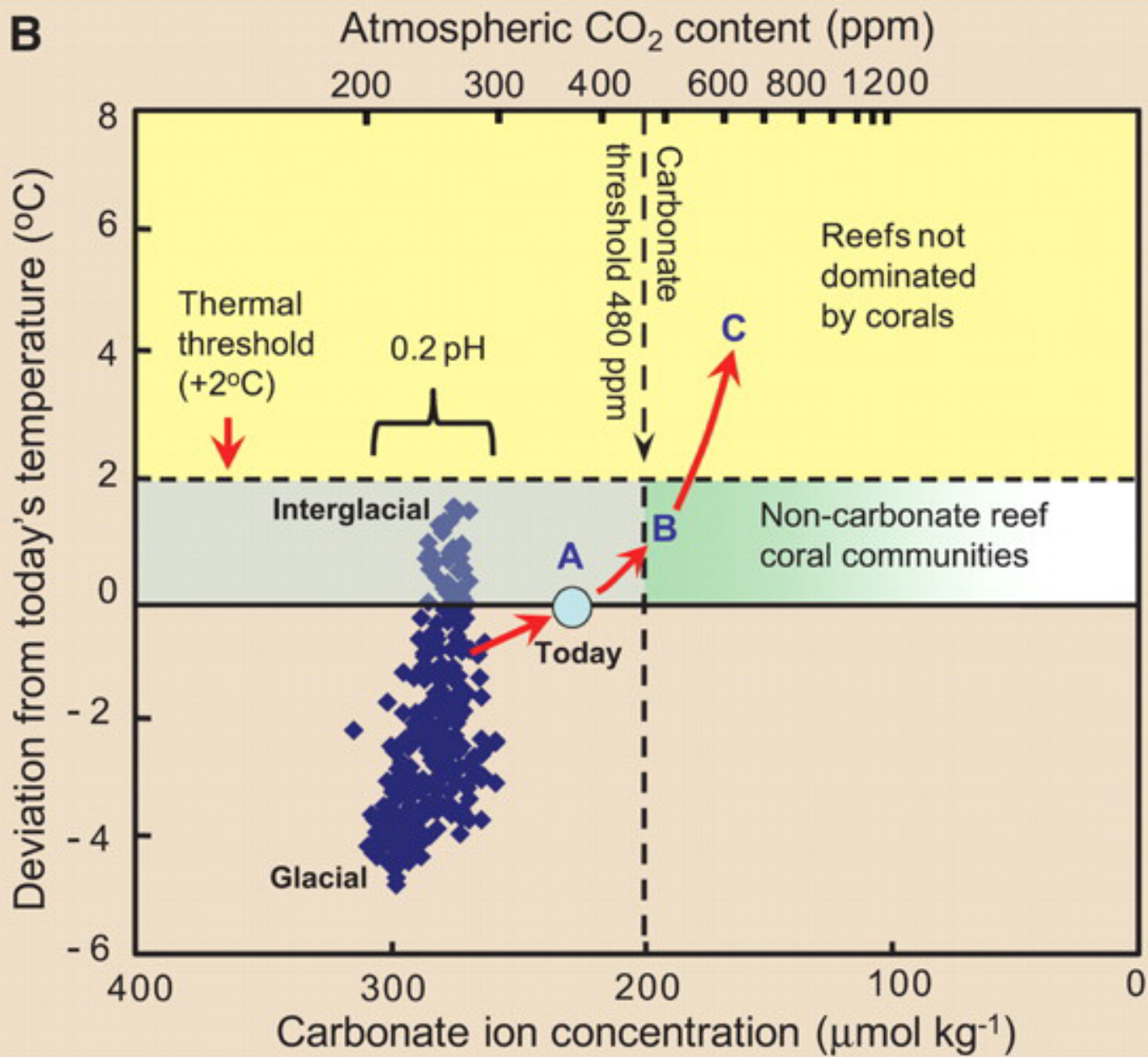




Rahmstorf 2006





**B**

# IPCC Scenarios

		A	B
	DRIVING THEMES	Economics	Environmentalism
1	Globalism		
2	Regionalization		

# IPCC Scenarios

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	DRIVING THEMES	Economics	Environmentalism
1	Globalism  Pop. declines after 2050	Economic and technological convergence	Economic and technological convergence
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1	Globalism  Pop. declines after 2050	Economic and technological convergence	Economic and technological convergence
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# IPCC Scenarios

		A	B
	DRIVING THEMES	Economics	Environmentalism
1	<b>Globalism</b>  Pop. declines after 2050	Market forces  Economic and technological convergence	Sustainable development  Economic and technological convergence
2	<b>Regionalization</b>  Pop. Increases continuously	Market forces  Slower economic growth	Sustainable development  Slower economic growth